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SOBRE LA APLICACION DE LA CIENCIA Y LA TECNOLOGIA
EN BENEFICIO DE LAS REGIONES MENOS DESARROLLADAS

Punto del programa : C.1.2

Uruguay

EL CREDITO AGRICOLA EN EL URUGUAY : SINTESIS DEL ANALISIS Y SUGESTIONES DEL PRIMER SEMINARIO NACIONAL DE CREDITO AGRICOLA (1959)

Por el Ing. Agr. Alfredo L. WEISS;
Director del Seminario,
Director del Instituto
de Economía de la Facultad
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Las monografías presentadas en la Conferencia de las Naciones Unidas sobre la Aplicación de la Ciencia y la Tecnología en Beneficio de las Regiones Menos Desarrolladas constituyen documentos de trabajo de dicha Conferencia. Se publican tal como han sido presentadas por los colaboradores y los puntos de vista expresados en ellas corresponden a los colaboradores. (Veanse notas al dorso.)

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EL CREDITO AGRICOLA EN EL URUGUAY.-

Síntesis del análisis y sugestiones del primer Seminario Nacional de Crédito Agrícola (1959). Director del Seminario: Ing.Agr.Alfredo L.Weiss, Director del Instituto de Economía de la Facultad de Agronomía de Montevideo.

I-OBJETIVO DEL CREDITO AGRICOLA Y MEDIO DONDE OPERA.

El objetivo que predominó en la posición de los integrantes del Seminario a través de todas las discusiones y cambios de ideas fue el de que el desarrollo económico y social del país tiene que ligarse estrechamente al mejoramiento y elevación del bienestar de los pequeños y medianos agricultores.-Lógicamente,para lograr este propósito,una de las herramientas de acción más positiva lo debe constituir una eficiente política crediticia.-

La política del crédito agrícola no puede formularse aisladamente respecto a la política económica general del país.-Si se inicia un programa o se quiere dar mayor énfasis a determinados aspectos del crédito agrícola,es necesario mantener una estrecha relación con el resto de los planes de desarrollo,tanto en lo relativo a la producción agropecuaria como a la industrial y la obra pública.-El Seminario coincidió respecto a la necesidad del establecimiento de metas de desarrollo,y dentro de las mismas,el señalamiento de los caminos y diferentes etapas que deben recorrerse.-Se entendió también que,dado la limitación que la precariedad de recursos significa normalmente frente a las necesidades de crédito,se hace imprescindible dentro de las normas antes señaladas,el establecimiento de prioridades.-

El conocimiento del medio en el cual habrá de aplicarse el crédito y las características de los beneficiarios reviste una gran importancia.-Es preciso en consecuencia,fijar criterio,de la manera más exacta posible sobre la situación del país,tanto desde el punto de vista económico-social como de sus recursos naturales,poniéndose énfasis en los aspectos relacionados con el destino y usos del suelo,problemas de comercialización y mercados,etc.-

Evaluadas las informaciones que sobre tales puntos se lograron en forma parcial y de acuerdo a sus actividades especializadas por Institutos de la Universidad,dependencias técnicas del Poder Ejecutivo,Entes Autónomos y Organismos Nacionales e Internacionales de índole privada,el Seminario las consideró básicas y entiende de interés recomendar que la Universidad de la República,a través del Instituto de Economía de la Facultad de Agronomía,y el Ministerio de Ganadería y Agricultura,por intermedio de su Departamento de Economía Rural,actuando conjuntamente,promuevan la coordinación necesaria para llevar a cabo de manera integral los estudios de referencia y las medidas conducentes a las aplicaciones concretas que de sus resultados se deriven,-

II-POLITICA CREDITICA ACTUAL.-

El Seminario acordó que es preciso lograr un cuidadoso conocimiento de como los agricultores utilizan su capacidad de obligarse con las diversas fuentes de crédito,en qué condiciones de montos,plazos,garantías,etc.lo hacen,que actitudes los llevan a la elección del crédito y en que realmente lo aplican.-En esa tesitura,el Primer Seminario de Crédito Agrícola sugirió que el Instituto de Economía de la Facultad de Agronomía-una vez dotado del personal y recursos necesarios- integrándose con otros Institutos Universitarios de Ciencias Sociales,y con la colaboración de los organismos oficiales y privados vinculados al problema,realice un trabajo de campo mediante procedimientos de muestreo representativo de todos los productores rurales,reuniendo además todo el material existente al respecto,a los fines de proceder al estudio del problema.-Esta investigación permitiría determinar la necesidad y el grado de una nueva orientación a las políticas crediticias,adecuándolas en forma regional y particular para un mejor aprovechamiento de todos los recursos productivos.-

III-FUENTES DE CREDITO.-

El Seminario analizó con mucho detalle las diversas fuentes crediticias existentes en el Uruguay.-Las mismas pueden clasificarse en dos grandes grupos.-Uno,el significado por organismos públicos y privados en cuyos cometidos o funciones la atención crediticia a las distintas manifestaciones de la agricultura se realiza en forma específica o reglamentarda.-El otro,constituído por prestamistas individuales,generalmente comerciantes.-

Las fuentes crediticias que se incluyeron en el primer grupo están representadas,dentro de los organismos oficiales por el Banco de la República,el Banco Hipotecario y el Instituto Nacional de Colonización,y los privados por instituciones bancarias,ya que las cooperativas u otros tipos de asociaciones de productores se encuentran,en el aspecto que se considera,en estado embrionario.-

Tanto los Bancos Oficiales como los particulares actúan a través de sus Casas Centrales y Sucursales y Agencias distribuídas en las capitales departamentales y algunas poblaciones de relativa importancia.-

Como conclusión final del estudio de las diversas fuentes crediticias,de modo especial las de caracter oficial,el Seminario sostuvo la necesidad de la creación de un Banco Agrario.-Entendió que en un país de economía fundamentalmente basada en la agricultura,es imprescindeble que las diversas actividades que la misma involucra sean atendidas en forma adecuada y con caracter preferencial.-En el Uruguay se encuentran servicios repetidos y que encaran en forma diferente los mismos problemas,existe asímismo desconección entre los diversos organismos oficiales,y todo ello origina pérdida de esfuerzos y de recursos por la falta de una coordinación conveniente en su manejo y destinos.-Por lo tanto,el Seminario creyó conveniente expresar a los Póderes Públicos la conveniencia de actualizar los estudios tendientes a la creación de un Banco Agrario en el cual se concentren orgánicamente todas las actividades que tiendan a la mejor atención de las necesidades de la agricultura.-Como base para dicho Banco se estimó pueden tomarse los servicios de Crédito Rural,Mercado de Frutos y Graneros Oficiales actualmente a cargo o administrados por el Banco de la República el Instituto de Colonización y el Sector Rural del Banco de Seguros del Estado.-Primando el concepto que mantuvo permanentemente el Seminario,se afirmó que era de fundamental importancia que la dirección de un organismo de las características específicas de un Banco Agrario quede a cargo de técnicos en la materia.-

IV-DISTINTOS TIPOS DE CREDITOS.-

Entramos ahora,en una enumeración de los tópicos analizados al estudiar los distintos tipos de créditos agrícola vigentes o de posible aplicación en el país.-Se comenzó por uno de los que más espectativa provocara en el país, o sea el Crédito Agrícola de Habilitación analizándose sus numerosas limitaciones.-

En resumen,el Seminario coincidió en reconocer que debía procederse a la revisión de la ley y reglamentación del Crédito Agrícola de Habilitación,tomando muy en cuenta entre otros puntos los siguientes:

a)Dar a este tipo de crédito,caracter integral haciéndolo extensivo tanto a producciones vegetales como animales o a la combinación o complementación de ambas.
b)Rebajar el límite de edad que rige para ser beneficiario del mismo.
c)Elevar y revisar constantemente los topes en cuanto al monto del crédito por productor.-
d)Ampliar la atención administrativa de su organización.
e)Incluir la adquisición de maquinarias y equipos en los rubros contemplados por la ley.
f)Evitar la invocación de esta ley para desviar sus recursos a otros destinos no vinculados al crédito agrícola.
g)Procurar que el crédito agrícola de Habilitación,pase a formar un capital especial dentro de la Ley Orgánica del Banco de la República,actuando como un servicio propio dentro de su Departamento de Crédito Rural.
h)Asegurar,paralelamente al otorgamiento del crédito,una asistencia técnica continuada,mediante el correlativo aumento de su personal.-

Se analizaron además cuidadosamente otras modalidades del crédito agrícola,entre ellas las de Habilitación Ganadera,el Orientado,el Dirigido,el Supervisado y el Cooperativo.
Respecto del crédito agrícola supervisado se le definió como un programa de crédito integral de naturaleza familiar,mediante el cual se procura por métodos apropiados,la capacitación de la familia rural con el objeto de habilitarla,técnica,económica y socialmente,teniendo en vista el mejoramiento a través de aquella de las condiciones de vida de las comunidades rurales.-

El Seminario reconoció reiteradamente los beneficios que cabe esperar de la implantación de programas de Crédito Agrícola Supervisado estrechamente ligados -más aún:inseparables- de los de Extensión Agrícola.-

Complementariamente se reconoció que dichos Programas necesitan personal especializado,llegándose a la conclusión,de que se requiere que éste reciba un entrenamiento adecuado en otras areas,nacionales o extranjeras que vienen desarrollando tal tipo de proyecto.-
Como antecedentes de aplicación,en nuestro medio,de Créditos Agrícola Supervisado se destacaron las realizaciones del Instituto Nacional de Colonización en Durable y del Instituto Interamericano de Ciencias Agrícolas en San Ramón.-

CREDITO COOPERATIVO.-

Al considerarse los aspectos relativos al crédito agrícola en relación con el movimiento cooperativo nacional se tuvieron en cuenta dos aspectos fundamentales que se diferencian en forma clara;uno es el que se relaciona con el crédito otorgado a las cooperativas agropecuarias o a sus cooperadores por instituciones de crédito públicas o privadas y el otro es el que se refiere al crédito cooperativo propiamente dicha o sea el que se otorgan a si mismos los asociados de una Cooperativa de Crédito Agrícola.-
Con respecto al primer punto,el Seminario se refirió en forma concreta a la necesidad de apuntalar económicamente el movimiento cooperativo agropecuario que actualmente existe en el país.-

En síntesis el Seminario después de haber formado conciencia sobre los problemas que aquejan al movimiento cooperativo Nacional en relación con el crédito agrícola formuló las siguientes sugestiones:

1°) Como medida de fondo,extender los beneficios que otorga la ley N°10008 de manera tal que favorezca la creación de cooperativas de crédito,e incluso su federación alrededor de un Banco Cooperativo.-

2°) Como medidas de aplicación inmediata hasta tanto no se alcance la solución anterior:a)Formación de una institución de tipo bancario con accionariado cooperativo,b)Creación de una Sección dentro del Departamento de Crédito Rural del Banco de la República -y a cargo de personal técnico especializado- encargado de otorgar y distribuir el otorgamiento de créditos a las sociedades cooperativas.-

3°) Que corresponde realizar esfuerzos para que los organismos financiadores de prestamos a las entidades cooperativas,se compenetren de que corresponde evaluar la garantía de índole moral que ellas constituyen,además de las de orden material que puedan ofrecerse.-

4°) Que el Banco de la República conceda un tratamiento preferencial a las operaciones planteadas por las Cooperativas Agropecuarias,además de prodigarles las liberalidades máximas que se estilan cuando se trata de productores directos.-

5°) Que en los casos en que los préstamos a las Cooperativas se respalden con garantía prendaria de productos agrícolas depositados arbitren fórmulas con suficiente latitud de manera que ellas no traben las operaciones normales de dichas entidades.-

6°) Que en cuanto concierne a las necesidades de las cooperativas en materia de construcción de edificios,depósitos e instalaciones inherentes a la conservación de productos,se considera conveniente dar amplia divulgación al texto de la ley N°12.314 que contempla expresamente estos casos.-

V-FUENTES DE FINANCIACION.-

El Seminario analizó,cual es la situación actual en cuanto a la disponibilidad de recursos pasibles de prestación y luego se consideraron cuáles podían ser,en un futuro inmediato las fuentes de financiación del crédito agrícola.-

Se cierra este informe enumerando las distintas alternativas-algunas de orden complementario que a juicio del Seminario podrán servir de base al estudiarse el financiamiento del Programa de Crédito Agrícola que requiere cada vez con mayor urgencia el Uruguay para acelerar su desarrollo económico:

1°) A los efectos de disponer de medios con carácter permanente y específica para atender las necesidades del crédito agrícola,cualquiera sea su tipo,el Seminario propició la formación de un fondo para cuya financiación se sugirieron las siguientes posibles fuentes:

a) Cuando los arrendamientos de predios sobrepasen una determinada proporción que habín de guardar con el valor de aforo de los predios debería el propietario abonar un gravamen porcentualmente mayor a medida que aumente dicha diferencia.-

b) Los predios cuya productividad se encuentre por debajo de los promedios zonales de los últimos cinco años deberían abonar un gravamen proporcionalmente creciente a dicha diferencia y a la extensión de los predios.-

c) El exceso de precios obtenidos por la exportación de productos primarios podría ser gravado al sobrepasar un 10% del precio internacional promedio de los últimos cinco años.-El gravamen será progresivo a medida que aumentara dicha diferencia.-

d) Sobre el monto total de exportaciones de productos primarios se descontaría pesos 0,05 (cinco centésimos moneda nacional)por Dlar.con destino a dicho Fondo.-Se incrementaría el tipo de cambio vendedor en esa cantidad.-

e) Mediante la revisión de la política de subsidios al trigo cabría gestionar que los fondos destinados anualmente a esos fines adjudicados a crédito agrícola especial (tal como podría ser:orientado,condicionado o supervisado),tendiente a la transformación de las explotaciones.-El monto requerido sería equivalente al 50% de lo entregado por concepto de subsidios en los últimos años.-

f) Un porcentaje de los recursos originados en la ley de excedentes agrícolas podría ser destinado al fondo de crédito agrícola.-

g) El impuesto a transacciones rurales que actualmente recibe la Caja de Jubilaciones Rurales de acuerdo al artículo 11 de la Ley de 5 de Diciembre de 1957 N° 12464,una vez financiadas las necesidades de aquel organismo podría ser destinado al fondo de crédito agrícola.-

h) Cuando la recaudación de los impuestos que percibe ganancias elevadas, sobrepasen el nivel de recursos establecidos como ingresos para el presupuesto vigente,el 10% del excedente sería vertido anualmente al fondo de crédito agrícola.-

2°) Ampliación hasta $10.000.000 (Diez millones de pesos)de los recursos destinados al Crédito Agrícola de Habilitación.

3°) Promover ante el Ministerio de Hacienda su pronunciamiento,sobre la ley de 16 de Noviembre de 1950 ya que se entendió que ésta habilita al Banco de la República a efectuar redescuentos de documentos provenientes de crédito prendarios sobre frutos del país cuando dichas prendas sean otorgadas a productores,y no solamente cuando se trata de comerciantes tal como se viene efectuando hasta ahora.-

4°) Tomar en consideración la posibilidad de que la Caja de Jubilaciones Rurales,Caja Nacional de Ahorro Postal y otras Instituciones Públicas o Privadas,inviertan parte de sus reservas en el fondo de crédito agrícola.

5°) Como medio indirecto para la preservación del fondo previsto se indicó que el lucro en los préstamos para para crédito agrícola debería limitarse a absorver el costo del dinero,la administración y las reservas para quebrantos,aconsejándose la adopción de intereses diferenciales mediante una regulación de las tasas que tome en cuánta la capacidad económica de los prestatarios y la naturaleza de las explotaciones.-

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FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: C.1.2

Uruguay

AGRICULTURAL CREDIT IN URUGUAY : SUMMARY OF THE ANALYSIS AND SUGGESTIONS OF THE FIRST NATIONAL SEMINAR ON AGRICULTURAL CREDIT (1959)

By Agr. Eng. Alfredo L. WEISS,
Director of the Seminar,
Director of the Institute of Economics
of the Faculty of Agronomy, Montevideo

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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AGRICULTURAL CREDIT IN URUGUAY

By
AGR. ENG. ALFREDO L. WAISS,
DIRECTOR OF THE SEMINAR,
DIRECTOR OF THE INSTITUTE OF ECONOMICS
OF THE FACULTY OF AGRONOMY, MONTEVIDEO.

I - THE AIMS OF AGRICULTURAL CREDIT AND THE CLASSES TO WHICH IT WOULD APPLY.-

The aim of the members of the Agricultural Credit Seminar predominating throughout all the discussions was that the economic and social development of the country must be closely bound up with the improved and increased wellbeing of small and medium farmers. One of the most important instruments in the achieving of this aim is an effective credit policy. This cannot be worked out in isolation from the general economic policy of the country. If a programme is launched or if greater emphasis is to be given to certain aspects of agricultural credit, close coordination must be maintained with other development plans, both as regards livestock and crop farming output as well as trade, industrial output and public works. All were agreed as to the need for setting development targets, stages to be gone through and indispensable priorities.

II - PRESENT CREDIT POLICY.-

On this subject it was agreed that it is necessary to gain a thorough knowledge of how farmers use their collateral with the various sources of credit, what amounts, repayment terms, guarantees, etc., are involved, what makes them seek credit and how they actually apply it.

III - SOURCES OF CREDIT.-

In the conclusion of their study of sources of credit, especially those of official character, the Seminar supported the creation of an Agricultural Bank which would incorporate all those activities that contribute towards a better attention to the needs of agriculture, and affirmed as a matter of basic importance that the management of this body should be entrusted to qualified experts in agricultural economics.

IV - DIFFERENT TYPES OF CREDIT.-

With regard to Credit for Farming Equipment all agreed that a revision of the law of the pertinent regulations should be undertaken, taking into account that it

should embrace all kinds of produce; that the age limit of beneficiaries should be lowered; that the level of capital loan sums be reviewed; that the purchase of machinery be included and that not only financial assistance but, together with it, continuous technical assistance be ensured. With regard to supervised credit for farmers - connected with "Agricultural Extension" - this was defined as an integral credit programme for families, through which and by appropriate means it is sought to equip the rural family technically. economically, and socially and by so doing to raise the standard of living of rural communities.

COOPERATIVE CREDIT.- After examination of the problems that afflict the national cooperative movement in relation to agricultural credit, the following suggestions were made: (1) As a basic measure, extend the benefits provided by law no. 10008 in such a way as to encourage the creation of credit cooperatives as well as their federation around a cooperative bank.- (2) Until such time as the foregoing is achieved: (a) the formation of a banking institution with a cooperative shareholding, (b) the creation of a Section in the Rural Credit Department of the Bank of the Republic responsible for the granting and distribution of credit grants to cooperative societies, (3) that bodies which finance loans to cooperative entities should be encouraged to bear in mind that guarantees of a moral kind should be considered in addition to those of a material kind that may be offered.

V - SOURCES OF FINANCE.-

The Seminar analysed, finally, the present situation as regards the availability of resources capable of being advanced on loan and deliberated on which could, in the immediate future, become the sources of finance for a National Fund specifically dedicated to the promotion of agricultural credit. Only some of these sources are listed hereunder: (a) when the rentals on landed property exceed a certain proportion that should be maintained in relation to its assessed value, the owner of the property will pay surtax on a percentage basis in respect of the aforesaid difference. (b) Farms with a productivity lower than the zonal average for the last five years will pay surtax in proportion to the said difference and to the size of the farms. (c) On the total sum of raw material exports a levy of 0.05 pesos (five centesimos national currency) per Dollar to be credited to this fund. (d) The Debt set aside for Agricultural Equipment Credit would be raised to Urug. $ 10,000,000.00 (ten million pesos).

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Agenda Item: C.2

United States of America

CHANGING DIETARY AND HEALTH PRACTICES

By Richard N. ADAMS,
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The University of Texas, Austin, Texas

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CHANGING DIETARY AND HEALTH PRACTICES

by

Richard N. Adams
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1. The purpose of this paper is to examine the adaptive character of behavior relation to illness and health, and to review briefly some of the general principles that are involved in instituting changes in these behaviors. Development is merely another name for on-going cultural evolution and it is the aim here to see the change in nutritional and dietary habits in this context.

Health, Ecology and Development.

2. It is important that those concerned with promoting better health and nutritional practices recognize that man is in constant competition with an increasing variety of insects, bacteria, viri, etc., as well as his fellow men. This on-going competition means that what is called "development", that is, the increasing control of man over the environment, is in fact a competitive process. Health and nutritional practices are merely one set of habits that provide man with more or less control over his environment. Illness, be it of nutritional origin or otherwise, simply reflects one aspect of the total adaptation of a population to the total environment and the particular niche it occupies therein.

3. There are two phases of ecological changes accompanying development that are of specific interest here, because of their effect on changing health and nutritional practices. One of these is the changing nature of the adaptive units of human populations as societies develop; the other is the acceleration of the use of energy and the increasing variety of energy forms used by developing societies. Each of these have important consequences for understanding changing health practices.

The Changing Nature of the Adaptive Unit.

4. As societies develop they tend to segment, not only into greater numbers of similar units, i.e. more towns,and villages, but also into increasingly different kinds of units, i.e. social classes, occupational groups, political, religious and ethnically identified groups, etc. The effect on health of these changes is immediately apparent when one contrasts the multiple peasant villages of some parts of the world with urban specialist groups elsewhere. In the former one looks for differences in illnesses and the mode of handling them on a geographical basis: Thus goiter is common to a region where iodine is deficient, and kwashiokor to populations in which the diet of young children after weaning is inadequate. While the cultures of each community within these populations are not entirely similar and internally homogeneous, most individuals in the communities are within a limited income range, share a generally similar adaptation pattern, and are, therefore, more or less open to the same maladies.

5. In more developed areas, the differentiating social entities manifest both different relationships with their environment, and different habit patterns in handling them. Thus as occupational specialty groups emerge, the particular habits of these trades breed specifically occupational diseases, old age diseases, over consumption diseases, poverty diseases, etc. Another feature of this differentiation is the emergency of segments that take it as their particular province to improve the health and nutritional adaptation of the rest of the segments.

However, these health action groups often forget that from the point of view of the population, they are merely one of a number of alternative resources, and that the benefits they offer are frequently not clear. The long-range benefits of "mental health" in the United States are as obscure to much of the U. S. population as are the use of latrines to many rural peasant groups.

An implication of this is that the health action worker must take particular pains to distinguish what is the meaningful environment of the particular group with which he is working. In both the more and less developed parts of the world, health action workers tend to come from the middle segments of the population. While they share common knowledge with members of their own segments, they face a common cross-cultural problem of understanding the adaptation and the views of the members of the other segments, both higher and lower. When they press for changing habits of health and nutrition, they are in fact pressing for a readaptation of those groups. And when it is realized that the health action worker's own views must reflect his own successful adaptation as a member of one kind of group, it becomes quite clear that it may be difficult for him to understand the perspective of another group.

The Acceleration of Quantity Production in Development.

6. Perhaps the most crucial underlying physical process that marks development is accelerating the conversion of natural resources into goods to be used and discarded by man. This process has two very direct effects on the changing of health and nutritional habits. It multiplies the number and kind of goods that are introduced into the health and curing process; and it multiplies the energy cost of production of foods and other elements in the health process.

7. The first of these points is fairly easy to see. The introduction of environmental sanitation means the introduction of goods produced in industrialized societies. Pipe, pumps, reinforced concrete, hardware, etc., are being introduced into the uttermost parts of the earth. Improved therapy usually means an increase in both quantity and variety of medicines to be applied to specific illnesses. The materials of scientific medicine and public health come, then in increasing quantity at exactly the same time that other competitive items enter the ken of the less developed society. The health action worker is not merely working against the current practice, but against competing new alternatives from other sources.

8. The implications of the facts that the energy cost of production increases are equally important. Development requires increasing the rate of converting the habitat into usuable items for man. This means both utilizing new energy sources, and consuming the materials converted. The increasing quantity of curing items just discussed is one way this is done. In the area of diet, the effects are equally profound. There is an increasing amount of energy spent in the actual production of foods, so that as development occurs, there is a change in the kinds of foods utilized. The major shift is from foods of high caloric content produced chiefly by hand agriculture, to a wider variety of foods of lower caloric content. There is, therefore, a general trend away from cheap, starchy staples, to foods of higher energy cost of production, although frequently lower in human labor cost.

9. The nature of this general trend is often obscured by the fact that within a developing country, various regions, localities and different emerging urbanized groups, will be developing at different rates. Also, where there exists the problem of keeping agricultural production ahead of the rapidly increasing population, much of the population continues on a marginal economic situation and is incapable of much participation in the development process. As a result, large segments of the population may often be suffering a stasis or even a setback. In addition to this irregularity, there are frequently strong seasonal variations in availability of goods, so that portions of the population will suffer severe nutritional deficiencies during some parts of the year. As well documented in children with Kwashiorkor, this reduces resistance to secondary infections.

10. The importance of recognizing these long-term trends, together with their social and seasonal variations, is, that the attempt to introduce certain types of new food habits may be much less appropriate than strictly nutritional considerations would lead one to conclude. The soy bean never caught on in the United States as a straight food product, in spite of considerable efforts to introduce it, because the trend was simply away from direct consumption of such foods. In the very laudable efforts to develop high protein food supplements in less developed areas, attention must be paid to which segments of the populations can be expected to utilize the new products.

Changing Knowledge and Practices.

11. If it can be accepted that the introduction of new health and nutritional practices is by way of a readaptation of a society to new circumstances, it follows that very real problems occur because no two situations are exactly the same. There are, however, some important consistencies in human society which can help the health action worker's understanding. Two areas will concern us here. First is the presence in all societies of "folk knowledge". Second are some basic processes which operate in innovation among all peoples.

Folk Knowledge and Practices

12. The ethnocentrism of developed societies has led their members to regard those who fail to act in accord with their own practices as being "ignorant" and "superstitious". This has led even specialists to try to contrast the "knowledge" that is to be derived from scientific work, with a thing they call "ignorance" which characterizes most of the world's peoples. This knowledge-ignorance dichotomy is misleading. The significant difference in this matter is not to be found between societies, but between the specialists and the non-specialists. In all societies, most people are non-specialists when it comes to matters of health and nutrition. Although the practices of some societies are clearly more efficacious, as measured in terms of mortality, morbidity, and life expectancy, that which the people in those societies "know" about how their own practices work, and how they may react to new practices is quite another matter.

13. So it is that "folk knowledge", and in the present instance specifically folk medicine, has mistakenly been thought to be peculiar to some "ignorant" segments of the world's population when in fact it is a kind of knowledge which characterizes in one way or another almost everyone in the species. Folk knowledge comprises that set of terms, practices, and ideas that are common to the non-specialists of the population. By way of example I can identify some practices and ideas from my own society, but this is done only from casual reflection and not as systematic observation. Besides being very bothered with "new kinds of virus" which seem periodically to pass across the United States, North Americans are also very bothered with the "common cold" a variety of upper and lower respiratory infection said to be derived from getting caught in drafts, or through contact with someone else who has one. Even the tiniest prick of the skin will send most North Americans to the medicine cabinet in search of a disinfectant "to kill the germs" and a bandage "to keep the wound clean". Now, it might be argued that some of these are well founded in scientific work; and this is probably true. But the people who carry on the practice carry it on because they were taught it as a practice, and not because they have themselves ascertained the scientific validity of what they are doing.

14. Accepting the idea that all societies have broad folk knowledge areas and that it is left to few to be specialists in any given area, it is legitimate to seek distinctions between the folk knowledge characteristic of more and less developed societies. Here again, the study of more developed societies is defective, but as a first approximation, we can suggest the following:

(a) In less developed societies there tend to be fewer elements (i.e. terms, material items in use) and those which are in existence tend to be more widely known and subject to very gradual change in usage. In more developed societies there are more items, there tends to be be a greater variation in their usage, and they are subject to much more rapid change.

(b) The more rapid change of the folk knowledge of the more developed society derives from the fact that there are specialized segments of the society devoted to creating and diffusing new elements, and among these, most important from our viewpoint, is the work of the medical scientist. There is a constant production of new knowledge, and portions of this filter down and become parts of the folk knowledge of the society. Since the production is continuing, folk knowledge is constantly being bombarded by new elements, and a residue is regularly incorporated.

(c) The folk medicine of more developed societies is more characterized by fads and fashions. Partly because of the constant availability of new elements, and partly because choice between new elements often therefore rests on social acceptability rather than tests of efficacy, some forms receive special favoritism.

15. It should be noted that we do not identify any particular forms, such as witchcraft, the use of herbal remedies, etc., as being the distinguishing features of folk medicine. These things may distinguish the folk medicine of many parts of the world, but different names have been applied to comparable practices in more advanced societies. The extraordinary faith placed in aspirin by many segments of advanced societies is certainly magic; the denunciation of one doctor and the worshipping of another is quite comparable to the shifting of healers found in less developed societies. Most uses of the term magic are so thoroughly ethnocentric that they can only be misleading.

Processes of Innovation

16. If we accept that folk knowledge is essentially comparable psychologically from one society to another, it also follows that the processes of change are comparable. Numerous studies, both in the more and less developed countries, have made it possible to identify some of these processes. Perhaps the most important is "rational behaviour". Given the particular body of knowledge of a people, and the set of values built into this knowledge, they will rationally choose what seems to be the best for them. That this is often ignored and occasionally denied by action workers rests on the fact that it may be difficult to understand clearly another person's culture, to see his point of view, and to make evaluations in terms of his concepts and values." It is even more difficult when the action worker is committed to his own values to the point of propagating them. It has long been apparent that mere daily contact over a long period of time with another people not only does not guarantee an understanding of their culture, but can even build almost impenetrable walls against such an understanding. It is easier to brand another as being "ignorant" or "stupid" than to admit that one is himself incapable of understanding them.

17. The essentially rational behavior of people is often further obscured by the fact that alternatives presented may be ambiguous. When this is the case, it is most common that resolution will either be avoided entirely or will be made on the supposed judgement of someone else. This someone else is called a "reference group". Thus, the individual trying to decide whether or not to accept an innovation being presented by a health action worker, will reflect on whether it will receive the approval of the people to whom he looks for approbation, or whether it will make him more similar to people he admires. The problem that faces all health action workers is that of identifying the reference groups that govern these kind of decisions.

18. Knowledge finds its social significance in the fact that it is shared with someone else. Every cultural element is so shared, and the particular finite set of individuals tied together through common sharing of a cultural trait comprises a social organization. In introducing a new item, one must presumably either follow through some existing social organization, or establish a new set of common

meanings and thereby a new social organization. Since few of the world's communities are developed enough to maintain active public health organizations, many new practices must be promoted through existing organizations such as clubs, civic groups and clique groups.

19. Considerable care must be exercised in identifying potential social relationships or organizations to serve as diffusion channels for new practices. Most communities have a few individuals of particular prestige who serve best as a focus for the diffusion of new practices. These may not be the individuals who most readily accept new practices, however, for the social position of a person may tell little about his psychological predisposition to innovation. Some early acceptors may be the most unsatisfactory from the standpoint of social prestige. Most communities have individuals who seek innovation to resolve personal problems. If these individuals stand in a position of low prestige, they may actually inhibit diffusion. The standing of the early acceptors is especially important in cases where the efficacy of the innovation is not immediately apparent and reliance must therefore be placed entirely on the opinion of one's fellows. It should also be noted that the acceptance by a person of high prestige does not guarantee widespread diffusion. The nature of his prestige must be such that he serves as a significant reference group for others. So far as we know, there is no essential difference between more or less developed societies in these matters. The definition of a reference group varies from one to another, and there may even be culturally established proper modes of imitation.

20. Besides the social relations involved in diffusion, the interpretation placed on a practice can be expected to change in the course of adoption into a new cultural setting. Before a new form is accepted it will be compared with what is known and it will be identified with something that is familiar and similar. In this way a meaning or idea already common in the society is extended to give a familiar association to the new form. If the similarity thus discovered is a pleasant one, the innovation is likely to be accepted; if it is unpleasant, then its acceptance is extremely inhibited. If accepted, however, the new meaning will be extended to the innovation and it will not mean exactly the same thing it did in the donor culture, and probably never will. This process has been called reinterpretation and signals the fact that in passing from one culture to another, a practice will almost always undergo a change in meaning.

21. Just as a new item will be judged in terms of what it is similar to, so the meanings associated with the new item will suggest to the acceptors that it be changed to fit in with what they already know. The health action worker must not be too demanding about whether the form he is promoting is accepted entirely as he finds it in his own culture. Wheat, when taken up by the high altitude Indians of Guatemala was not adopted as leavened bread familiar to Spain, but converted into tortillas, the griddle cake standard for aboriginal corn. In more developed cultures, millions of dollars are spent annually in packaging to make a product more acceptable in shape, size and decoration. This, of course, is part of the increasing energy cost of production mentioned earlier; but the principle operates anywhere that an innovation is being promoted.

Research and Development in Action Programs.

22. The introduction of new health practices is essentially a process of readaptation of a people to a changing environment. The specific psychological processes require that there be some understanding of the social organization, and the cognitive and value systems of the people to gain cooperation. We must, therefore, look to the kinds of action program that may be most effective for this.

23. In general, health action workers have tended to look upon the development process as a simple means-end issue. A given condition now exists; another condition is more desirable, and means are set up to accomplish the more desirable condition. The vocabulary of development has evolved around this basic theme. We speak of "sponsoring agencies", "target populations", "take-off", "great leap", "five year plan", of peoples being "resistant to change", of "achievements", and so forth. In cases where

the aim is to alter specific environmental elements or specific physical or material phases of the culture, the means-ends approach has often proved to be successful or at least promising. The introduction of iodine into salt to prevent goiter, the eradication of malaria, and the establishment of water and drainage systems are programs that are trying directly to create a new environment.

24. When one turns to changing practices and habits that cannot be changed through directly altering the habitat, the means-ends program has not proved to be sufficient. Health education has occasionally proved effective, but has usually been the weakest part of the public health effort. The readaptation of behavior can be more successfully introduced through a process that frankly apes the evolutionary adaptation. Following preliminary investigation, an innovation is attempted. Careful observation of the results provides feedback that leads to further investigation and further innovation. There is nothing basically new in this "research and development" process. In essence, it was the basis of the entire Land Grant College system that was so important in the agricultural development of the United States. The land grant college provided a local research center that could teach and focus on the immediate problems of the area. Coupled with the country extension agent, the land grant college provided the research and development basis for working directly with the United States farmer. The success of the land grant college has not been entirely lost on other countries, and there are numerous attempts underway to graft the system on to other national establishments. This success of the land grant effort, however, lay in its early design to fit the agricultural, economic and social conditions of the time. It is, therefore, not the specific organization of the land grant college that is so important but the basic principles of research and development around which it was conceived.

25. The crucial features of these research and development methods include the following:

(a) A permanent research and teaching organization receives continuing financial support and is free from political interference and direction except within the total structure of the entity providing support. While the major goals of the organization obviously must be in accord with the general philosophy of the maximal supporting political entity, the year-to-year work and day-to-day activity cannot be inhibited by the internal political vagaries of that political entity, or the research effort cannot achieve the necessary continuity.

(b) The organization must be closely linked to various individuals and other agencies that are involved in action programs so that research may immediately be translated into action, and the results fed back to the research organization for further examination. It is this constant interplay between the laboratory, so to speak, and the field, that provides the crucial adaptive quality of this kind of program.

(c) The translation of research into action must be carried on with the specific individuals for whom the research is being done so that the application of research results comprises the actual adaptation of those individuals. The process thus requires that the individuals whose habits are to change, be participant in and cognizant of the process.

26. In ecological terms, the research and development process provides the only way thus far developed for directed culture change to make allowance for the numerous regional and local variations that characterize human adaptation. It rejects the idea that any specific formal behavior is appropriate for all populations unless the issue involved is one common to human adaptation everywhere. It recognizes that every population exists in a slightly different environment, has made a different adjustment to it, and that the success of the development of each lies in a process of readaptation.

For general reviews of the subject, the reader is encouraged to refer to the recent paper by Polgar. From it one may be led to the other literature in the field. Other recent reviews include Rubin and Hughes.

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: C.2

United States of America

CHANGING DIETARY AND HEALTH PRACTICES

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

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CHANGING DIETARY AND HEALTH PRACTICES

by

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SUMMARY

1. Health and dietary habits are devices by which a population adapts to its habitat. The process called "development" refers to a double change: the population accelerates the exploitation of the habitat such that the habitat changes. Within the society there is an increase in complexity such that new social groups and segments emerge, thereby providing each segment with a new social habitat. Development demands a constant readaptation of the population, both socially and environmentally. The new groups, because of their specific activities and contacts, develop new disease syndromes peculiar to themselves. A consequence of the acceleration of exploitation of the habitat is the more rapid utilization and expenditure of the products. This means that new foods and new food processing is developed. The same occurs in sanitary technology and medical therapy, where increasing quantities and varieties of materials are utilized to achieve hygienic conditions.

2. The attempt to introduce new practices, however, faces two conditions: one is the presence of knowledge in the society; the other is the nature of the socio-psychology of innovation and acceptance. In all societies we can distinguish the knowledge of the non-specialist, that is the "folk knowledge" from that of the specialist. It makes no difference how developed a society is, the great majority of the people have a folk knowledge of health. Practices, learned from seniors and peers, are carried out both because they are socially reliable and because there is some evidence of efficacy. More developed societies have a folk knowledge that has more elements, changes more rapidly, and is more subject to fads. Changing folk knowledge faces essentially the same problem in all societies. When alternatives are clear to people, they will make rational choices in terms of their understanding and values. When choices are ambiguous, and a choice must be made, they will look to a reference group as a guide. Thus social approval will often supplant medical logic. Much more often than not, the apparent "irrationality" of people refusing to accept innovations is due to the ambiguity of the alternatives. This means that health-action workers must learn better how and what to communicate into other social groups.

3. The actual application of health programs has often been done on the means-ends model. That is, a given set of conditions is desired, and steps are taken to achieve these goals. While this may work in cases where the goal is modification of the environment (as is the case in environmental sanitation and in the eradication of certain diseases), it cannot be expected to work well where changing habits is the crucial issue. Here it is necessary to model projects after evolutionary processes, and see the acceptance of new traits as a continuing readaptive process of the popluation. Analysis of innovation failures must be fed back and help modify innovation attempts. This process, recently called "research and development", has a long history. It was the basis for the success of the Land Grant College system that has made the United States the leader in world agriculture. As a principle, it must be applied to the design of health programs if they are to help the people of the world readapt to the constantly changing environment.

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Agenda Item: C.3.4

Uganda

EXPERIMENT AND EXPERIENCE IN CROP ROTATIONS

By John M. MUNRO

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EXPERIMENT AND EXPERIENCE IN CROP ROTATIONS

by

John M. Munro

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1. The ideal crop rotation is one which maintains or increases fertility while producing an economic return in crop or animal products. In primitive agriculture, this is usually achieved by shifting cultivation, where an area of land is cleared from bush or forest and cropped until the return becomes uneconomic; this area is then abandoned and a fresh area is cleared and cropped. Shifting cultivation in the savanna regions of Africa usually allows two to four years' cropping, followed by a recovery period lasting at least six years during which regeneration of indigenous species occurs; in humid tropical forest zones a much longer period of regeneration may be required (1).

2. With a low population density and plenty of land available, this system is adequate. All over the world, however, populations are increasing, and the problem in developing countries is how to feed this increased population while maintaining soil fertility. What has generally happened is that shifting cultivation has been carried on, but the recovery period has been more and more curtailed; fertility has fallen, more land is required to produce the same output, and the period of regeneration is shortened still further.

3. In Uganda, largely as a result of Martin's work (2) on the improvement of soil structure under grass, what is known as the 3:3 rotation has been advocated in the tall grass areas since 1934; in this rotation three years of arable cropping is followed by a three year recovery period under grass. Two years of arable cropping instead of three was recommended in the short grass areas. Many territories in Africa - Tanganyika, Kenya, Nigeria, the Rhodesias and Nyasaland - have based their cropping recommendations on this 3:3 rotation (3), although the effect of grass on the soil structure has been shown to be more transient than was thought at first (4).

4. One of the most difficult problems facing the agricultural scientist is the assessment of the value of a rotation in maintaining fertility, and the comparison of different rotations from this point of view. The choice of crops and of crop sequence is relatively a simple matter.

5. The choice of crops to be grown is based in the first place on what crops have been grown in the past, when trial and error decided the crops which were suited to the area and which found a ready market. This is developed by the selection and testing of improved indigonous varieties, and the introduction of varieties from other parts of the world. At the same time the development of communications widens the possible market, and new crops which have little or no local value, but can compete on the export market, are introduced and tested. As local industry develops, these crops may find a new market in the country where they are being grown. In the more highly developed countries, retail distribution is highly organized, and it is no longer necessary for the farmer to grow his own food; this type of development should be borne in mind in countries where subsistance farming with some production of cash crops is still the rule.

6. Having decided on what crops to grow, the sequence depends on the climate, length of growing season, and any interaction which may occur between crops. The first two are important in the equatorial belt where there are two rainy seasons a year, and where irrigation gives a wide choice of growing season. In both cases, peak water requirement should coincide with peak rainfall, and harvest with a relatively dry period. Timing is of great importance where two crops a year are taken, and the crop sequence must be arranged so that one crop is off the ground in time to plant the next crop at the optimum date. With one rainy season and one crop a year there is plenty of time during the dry season to prepare for the next crop. Rotations must be tried out on a farm scale before they can be recommended for general use, to ensure that no practical difficulties exist.

7. Some crops do better than others immediately following the regenerative period: cotton is recommended as an opening crop in Uganda (5), and groundnuts or tobacco in Nyasaland (6). Two year crop sequence trials have proved useful in Nigeria (7) and Nyasaland (6); in the latter, maize yields are found to be highest following a groundnut crop.

8. Intercropping - the planting of more than one crop on the same land in the same season - has for long been practised in Africa and elsewhere, and may be regarded as an alternative to the rotation of arable crops in pure stand. It is often difficult to compare such systems, which differ in the proportions of two different products, but recent work in Tanganyika (8) and Nyasaland (9) has shown that intercropping may result in higher total production per acre. Little or nothing is known of its effect on soil fertility.

9. As agriculture develops, increasing use will have to be made of cattle manure and artificial fertilizers to maintain and increase fertility. Where cattle are kept, traditional methods include not only the grazing of crop residues but also grazing of uncultivated rough pastures; the cattle are herded in a kraal or boma during the night. Cattle manure is therefore derived from outside as well as inside the rotation, but with more intensive cultivation the scope for free range gets less, and the ultimate aim must be the maintenance of fertility in a closed system as far as animal manure is concerned, but with increasing use of artificial fertilizers.

10. In a closed 3:3 rotation an output of half a ton per acre per annum of cattle manure is unlikely to be exceeded (10), which allows an average application of one ton per acre per annum to the cropping phase. Experiments at Serere in Uganda (11) (18) show that in a grass-arable rotation 2½ tons per acre every five years seems just sufficient to maintain existing fertility; 10 tons per acre every three years appears necessary to maintain continuous cropping. Continuous cropping in Tanganyika (12) with 6 to 7 tons per acre of cattle manure every fifth year gave yields equal to those following a five-year period of grass; double super phosphate at 200 lb. per acre gave similar results.

11. In Africa (13) as in England (14), it seems that the main value of cattle manure derives from the plant nutrients it contains, but the organic matter may play a part in delaying their release and in preventing the fixation of phosphates in certain soils (15).

12. There are many problems connected with the use of restorative crops in a rotation which have scarcely been touched so far. Probably the main stumbling block to the general adoption of a 3:3 or similar rotation is the question of an economic return from the land during the recovery period. In temperate climates, grass/legume mixtures are remunerative as a source of meat and milk; only now is this development starting in tropical and subtropical Africa. Milk production is remunerative when European breeds of cattle are maintained, but this entails a revolution in cattle management, with protection against tick-borne diseases, improved pastures, fencing and often conservation of fodder for the dry season. Beef production also requires a complete break with the tradition that cattle are an indication of wealth based on numbers alone, and a change to the concepts of quality beef and gain in live weight per acre per annum.

13. An alternative to beef and milk, especially where tsetse fly prevents the keeping of cattle, is the use of restorative crops producing a marketable product other than grass. Cassava weeded in the first season only has been shown to be as effective as grass in Tanganyika (12); in Nyasaland and Nigeria (3) pigeon pea (Cajanus indicus) is a possible alternative, while in Uganda (16) sugar cane in a 4:4 rotation is being used.

14. Much work remains to be done on the efficiency of different species of grasses and other crops in restoring fertility, alone and in combination with manuring. On the other hand there is some confusion as to what should be classified as "exhausting" crops; a distinction must be made between the direct effect of the crop and the effect of the cultivation methods. Cassava growing in Malaya is controlled by legislation, because it has rendered many acres of land useless for cultivation, in contrast to the restorative effect mentioned above in a rotation in Tanganyika.

15. Another difficult problem is the effect of the grazing animal on the restorative effect of a grass ley. Does grazing reduce or enhance this effect, and is there a difference in the effect of day time grazing only and the grazing of fenced paddocks day and night? Is maximum fodder production compatable with the maximum restorative effect?

16. The difficulty of assessing the value of a rotation in maintaining fertility lies chiefly in the length of time that is required. The most obvious measure of fertility is yield, but the effects of changes in fertility are usually small compared to variations in yield from season to season in tropical and subtropical regions. Yields from unreplicated plots are of little value unless they extend over very long sequences, although it may be possible to improve their value by some correction for climatic variation and position in the sequence of cropping.

17. Rotation experiments are exceedingly difficult to plan satisfactorily, and the results may only be relevant to a restricted area. In the first plance the number of possible permutations is usually very great, and only a few can be accommodated in an experiment of reasonable size. Secondly, to measure seasonal variations, all phases of the rotation should be represented each season; if six-year rotations are being tested, this multiplies the number of treatments by six. Thirdly, to accommodate the large number of treatments, replication may be restricted and statistically valid results may only be available after twenty years or more (17) (18). Fourthly, by the time that results become available the rotations tested may have been superseded as a result of information from other sources. Fifthly, the varieties used when the experiment started will almost certainly have been replaced by improved varieties.

18. The size and complexity of rotation experiments is such that few comprehensive trials have in fact been laid down and maintained. The Serere experiment in Uganda (11) was started in 1936, but the results of the first four completed cycles have not yet been fully analysed. At the Gezira Research Station in the Sudan a three-course rotation experiment was started in 1925, and the Combined Rotations experiment in 1931 (17).

19. To find the answers to the many problems of maintaining fertility by the conventional methods of rotation trials will involve an immense

programme of experiments and many years of work. A better knowledge of the principles involved would produce results in less time and of much wider application. These principles may be roughly divided into three - chemical, physical and climatic - although these will inevitably overlap and interact with each other.

20. In the past the chemical approach has been largely static: soil surveys have outlined the main edaphic and ecological areas, and in these the major nutrients have been measured on the sites of experiments, and the response to known applications of fertilizers have been measured by crop yields. The estimation of "available" nutrients necessitates arbitrary methods of extraction, and correlations between soil analysis and crop reaction to fertilizers has often been disappointing; a method which gives good results in one area is frequently unsatisfactory in another.

21. More attention has recently been given to the more accurate study of the movement of nutrients in the soil profile and in the plant material throughout the cropping and recovery periods of a rotation (1); leaching and the release of nutrients by weathering are also included. At the same time the movement and uptake of added fertilizers is being studied in the soil and in the crop (19).

22. The physical approach has already been touched on with reference to the effect on soil structure of grass roots (para.3). We need to know more about the influence of soil structure and texture on water penetration and water holding capacity, on soil aeration and drainage, and on the absorption and release of nutrients and their uptake by the plant. Mechanical cultivation can have a much more drastic effect on structure than the hand hoe which it is replacing as agriculture develops. Does organic matter have any appreciable effect on the physical properties of soil in the tropics?

23. Rainfall intensity affects the surface structure of the soil, and the translocation of nutrients depends on soil moisture; the climatic approach therefore is complementary to both the physical and chemical aspects. The water balance is dependent not only on the rainfall and water penetration, but also on the rate of evapotranspiration, involving solar radiation and energy balance. The hydrological balance depends largely on land use (20), and may have important effects on the availability and uptake of nutrients. Water and temperature affect the rate of weathering of soil minerals, and hence the chemical and physical changes going on.

24. A combined approach along these lines to the basic factors determining soil fertility should give us a much better understanding of the processes by which fertility is built up and maintained. It will help to interpret what is happening in rotation trials, and to extend their applicability beyond the site where they are carried out. It should also provide a link between long-term rotation trials and those of shorter duration which are more easily

carried out; and suggest new methods of maintaining and increasing fertility under more intensive cropping in the developing countries where this is of fundamental importance.

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: C.3.4

Uganda

EXPERIMENT AND EXPERIENCE IN CROP ROTATIONS

By John M. MUNRO

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EXPERIMENT AND EXPERIENCE IN CROP ROTATIONS.

by
John M. Munro.

Increasing pressure of population in developing countries necessitates an increase in agricultural production. Traditional methods of shifting cultivation are unable to provide this while at the same time maintaining or increasing the fertility of agricultural land.

Many African countries base their cropping recommendations on a grass/arable rotation, first advocated in Uganda. The choice of crops and the order in which they are grown in the rotation are matters which can be decided relatively easily from short-term experiments and economic considerations.

Intercropping, cattle manure, artificial fertilizers, the economic value of grass, the effect of grazing on restoration of fertility and restorative crops other than grass are discussed.

The main difficulty facing the agricultural scientist is the assessment of the value of a rotation in maintaining fertility. Annual records from unreplicated plots or actual farm rotations are only useful when they are available over very long periods. Replicated rotation trials are very complex, and may not give statistically valid results until they have been running for many years. Only a few rotations can be included, and the need to include all phases of the rotation in any one season severely restricts replication. The rotations tested and the varieties used as indicator crops may be out of date before results are available. Few comprehensive trials here in fact been laid down and maintained.

A better knowledge of the principles involved in the decline and improvement of fertility is required so that trials may be simplified and their results may be of wider application. These principles may be studied by using three methods of approach - chemical, physical and climatological.

The chemical approach follows the cycle of the main nutrients through the rotation in the soil profile and the crops being grown; and the effect on these cycles of weathering, leaching and the addition of fertilizers.

The physical approach studies the texture and structure of the soil; the effect on these of different crops and manures, and how physical conditions affect the movement of moisture and nutrients in the soil and into the plant.

The climatological approach studies the acceptance of rainfall, the hydrological balance in the soil, and its effect on physical and chemical changes.

Elucidation of these principles should help to interpret the results of existing trials, allow the results of shorter-term trials to be integrated into a picture of wide applicability, and suggest new methods of maintaining an intensified agriculture.

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CONFÉRENCE DES NATIONS UNIES
SUR L'APPLICATION DE LA SCIENCE ET DE LA TECHNIQUE
DANS L'INTÉRÊT DES RÉGIONS PEU DÉVELOPPÉES

Point de l'ordre du jour : C.1.3

Côte-d'Ivoire

SENSIBILISATION DES MILIEUX RURAUX TRADITIONNELS A UNE AGRICULTURE DE TYPE EVOLUE PAR LES CENTRES-PILOTES DE PREVULGARISATION ET DE DEMONSTRATION

Par J. E. LALANDE,
Inspecteur général de l'Agriculture Outre-Mer,
Conseiller Technique aux Etudes
et à l'Expérimentation Agricole en Côte-d'Ivoire

Les mémoires rédigés à l'intention de la Conférence des Nations Unies sur l'application de la science et de la technique dans l'intérêt des régions peu développées sont des documents de travail. Ils sont publiés tels qu'ils ont été présentés et les assertions et opinions qu'ils contiennent sont celles de leurs auteurs.

NOTES

1. Les mémoires choisis pour être présentés en séance générale pourront être obtenus à la Conférence dans les langues officielles suivantes des Nations Unies: anglais, espagnol, français et russe.

2. Les mémoires choisis pour être présentés en séance spéciale pourront être obtenus à la Conférence dans l'une seulement de ces langues officielles.

3. Les résumés qui ont été rédigés pour tous les mémoires par les auteurs de ceux-ci pourront être obtenus à la Conférence dans les langues officielles suivantes des Nations Unies: anglais, espagnol, français et russe.

4. Préalablement à la Conférence, les mémoires et les résumés ne feront pas l'objet d'une distribution générale mais d'un tirage restreint destiné aux délégations des gouvernements et autres participants officiels. La publication et la distribution générale des actes de la Conférence s'effectueront conformément aux règles et pratiques agréées par le Comité des publications des Nations Unies.

Physionomie Générale de l'Agriculture Ivoirienne

L'Agriculture ivoirienne dans son ensemble, que ce soit dans son Secteur des cultures d'exportation, que ce soit dans son Secteur d'économie rurale traditionnelle (cultures vivrières), présente un caractère général : la médiocrité de ses rendements.

Cette faible productivité résulte de nombreux facteurs, entre autres :

- Statuts coutumiers fonciers
- Systèmes culturaux primitifs attardés dans une agriculture de subsistance (Secteur traditionnel notamment)
- Caractère extensif des cultures,
- Absence générale de fertilisations
- Equipement précaire des milieux ruraux
- Techniques d'exploitations sommaires
- Abaissement du niveau de fertilité des terres,
- etc, etc, etc,

Bien de ces facteurs sont particulièrement agissant dans le Secteur d'économie rurale traditionnelle, qui s'étend sur les zônes à saisons contrastées, et ou l'exploitation, de règle générale, est itinérante. D'autre part l'accroissement de la population y étant plus accusé, oblige dans certaines zônes à réduire la durée des jachères. La régénération des terres agraires est de ce fait incomplète, ceci traduisant par leur appauvrissement, voire même par leur dégradation.

Le problème qui se pose à cet égard à la Côte d'Ivoire, n'a pas échappé à l'attention du Gouvernement, qui a inscrit le Développement rural, par la modernisation de l'Agriculture, au premier rang de ses préoccupations.

Un ensemble de mesures ont été d'ailleurs décidées dans ce but. Entre ces mesures il y a lieu de citer notamment :

- La formation d'un encadrement de base,
- L'amélioration de l'équipement rural,
- La constitution et la mise en place de Centres de coopération
- La création de Stations Régionales d'Expérimentations qui avec les Instituts de Recherches spécialisées, travaillent à l'amélioration du matériel végétal, et à la mise au point des techniques de production.
- L'institution enfin du Crédit National Agricole.

etc, etc.

Ces mesures pour être à n'en pas douter fondamentalement nécessaires, n'en restent pas moins quelque peu illusoires, en tout cas certainement incomplètes. Illusoires selon nous, parce qu'on ne saurait les étendre, les mettre en application partout en même temps, dans un monde rural à la fois si diversifié et si généralement imprégné des coutumes ancestrales. Incomplètes parce que ces mesures ne peuvent avoir une véritable efficacité que si les milieux ruraux sont préalablement sensibilisés à la notion de progrès. Qu'après pourrait-on-dire leur

"conditionnement Psychologique" qui les rendent plus receptifs. D'où la nécessité urgente de multiplier préalablement sur des points d'impactes ruraux, en les dispersant dans les différentes régions, des actions Psychologiques, d'éducation et de démonstrations d'Agriculture progressive.

II Centres-Pilotes - Définition - But - Objectifs

Les Centres Pilotes de prévulgarisation constituent un mode de vulgarisation agricole par actions approchées et concentrées sur des points d'impacts ruraux.

Ces actions s'inscrivent dans le cadre d'un plan cultural établi préalablement à partir d'études de base sur le milieu rural concerné. Ces actions doivent tendre surtout à modifier les méthodes culturales traditionnelles dans ce qu'elles ont de sommaire et d'incomplet. Et les Techniques appliquées et enseignées, pour s'inspirer des données ou des mises au point obtenues en Stations d'expérimentations, n'en doivent pas moins au tant que faire se peut, être à la portée des moyens et de l'entendement du milieu.

Un Centre Pilote ne doit pas réformer ex abrupto les pratiques traditionnelles, Ce serait une faute de Psychologie, peut être même une imprudence, parce qu'en ce faisant, on risque de troubler un équilibre alimentaire qui, pour précaire qu'il soit, n'en existe pas moins.

En Résumé, les Centres-Pilotes dans les milieux ruraux de leur emprise - trop souvent résignés par inertie ou habitude, dans la coutume et la précarité - doivent s'attacher par leurs conseils et leurs démonstrations pratiques, à montrer l'intérêt par exemple, de telle ou telle Technique, de l'emploi de telle semence améliorée, des fertilisations organiques et minérales, de l'utilisation des bovins comme source d'énergie pour les travaux agricoles et les transports, des légumineuses de couvertures ; etc, etc...

C'est en faisant constater de visu en effet aux collectivités intéressées, que ces pratiques simples et nouvelles, se traduisent presque toujours par un accroissement de production et partant, de prospérité, que l'on peut espérer les convaincre et les voir adhérer à ces méthodes.

Telle est en fait le but majeur des Centres-Pilotes que d'aider, d'enseigner, et d'amener ainsi, les collectivités paysannes approchées à évoluer psychologiquement et techniquement.

Autres actions bénéfiques des Centres-Pilotes :
A l'intérieur du cadre paysannal où ils exercent et entre les participants à leurs entreprises, ils permettent de détecter les paysans plus réceptifs, mieux doués, plus ou moins concients déjà d'une évolution nécessaire, d'en faire des "hommes pionniers", des Agriculteurs-Pilotes, susceptibles d'entrainer les hésitants, les tenants de la coutume, d'être par surcroît des exemples pour les jeunes dont beaucoup désertent les campagnes.

Ils doivent d'autre part - et c'est un de leur rôle essentiel - pousser, décider leurs participants à s'associer en groupement professionnel, dont les Agriculteurs-pilotes précités seraient tout désignés pour être les animateurs. En développant par ce moyen l'esprit d'entr'aide, ces groupements, véritables cellules de base d'une coopération bien comprise, évolueraient nécessairement en Coopératives de village qui se rattacheraient aux Centres de Coopération déjà en place...

Aux Structures traditionnelles s'opposant trop souvent à toute évolution, se substituerait ainsi, une organisation professionnelle, devenue consciente d'une nécessaire solidarité paysanne.

Il vient à l'esprit immédiatement, ce qu'une telle transformation dans les moeurs permettrait d'entrevoir : (facilités d'obtention des crédits de campagne, de redistribution et de commercialisation des produits, etc, etc).

Mais au délà de ses effets internes, les Centres-pilotes ont une influence extérieure par leur vertu de "rayonnement" et de "contagion". Car rien n'est plus contagieux en Afrique Noire que le désir de prospérité.

Les prémières tentatives faites dans ce sens en Côte d'Ivoire (Secteurs-Pilotes) ont confirmé la sensibilisation effective, certaine, qu'exerce de proche en proche, ce procédé de vulgarisation.

En apportant la prospérité dans un milieu rural (village ou terroir), le Centre-Pilote ne peut pas ne pas forcer l'attention des collectivités avoisinantes, de susciter chez elles, plus ou moins confusément, un désir d'imitation, une volonté de progrès.

Et cette influence se réduirait-elle seulement à celà; qu'elle serait déjà bénéfique, en ce sens qu'elle prépare, prédispose, sensibilise, ces collectivités à une modernisation rurale.

Les Différents Aspects d'un Centre Pilote conditions d'Implantations

Les Centres Pilotes peuvent présenter plusieurs aspects et varier notamment dans leur dimension. Leur raison d'être, nous l'avons vu, est d'adapter leurs interventions et leurs entreprises à l'importance ethnique et aux possibilités des milieux où ils s'implantent.

La dimension minima d'un Centre Pilote ne peut être cependant que le village. Mais il peut étendre son emprise sur un terroir groupant plusieurs villages, de même ethnie et de même statut agraire, pour l'aménager et le moderniser dans son ensemble.

Si dans les Centres-Pilotes de petite dimension, la pratique de la culture attelée doit constituer un thème majeur de vulgarisation, dans les Centres-Pilotes-Terroirs, une méca-

nisation-(bien comprise s'entend)- est souhaitable, autant pour ménager les efforts des cultivateurs que pour hâter des travaux saisonniers urgents, qui constituent souvent des goulots d'étranglement difficiles à surmonter.

On peut concevoir également un Centre Pilote constitué par un groupe de jeunes ruraux épris de progrès, désireux de se libérer des contraintes coutumières et s'installant sur un domaine vacant pour s'adonner en commun, avec l'aide d'une Assistance Technique soutenue, à une agriculture de type évolué.

Le Centre Pilote doit en définitive s'accommoder de toutes les circonstances, de tous les milieux comme de toutes les bonnes volontés.

Un Centre-Pilote - cela est important - ne doit et ne peut en effet s'installer dans un milieu rural traditionnel, que s'il est accueilli sans réticence par la collectivité. Après cette adoption, et avant que le Centre-Pilote engage toute action, le milieu rural "accueillant" fait l'objet d'études préliminaires pour dégager le maximum de données sur son contexte humain et physique : études socio-économiques ; études agro-pédologiques du domaine ressortissant au milieu, carte d'utilisation des sols et relevé cadastral des champs ; accessoirement, études Topographiques et hydrologiques pour travaux éventuels de protection de sols ou d'aménagement hydro-agricole.

Comme il a été dit, ces études permettent d'établir en connaissance de cause, le planning des interventions du Centre tant sur le plan Technique que psychologique.

Une des conditions fondamentales à la réussite d'un Centre-Pilote, c'est la présence permanente auprès de la collectivité à "sensibiliser", d'un Animateur de base parfaitement instruit de sa mission et possédant de surcroît une sorte de mystique du progrès rural.

Cette condition est la plus difficile à satisfaire. De tels intermédiaires entre les techniciens de l'Assistance Technique et la collectivité, étant encore trop rares en Côte d'Ivoire.

Financement de démarrage d'un Centre-Pilote

Sans doute pour être plus immédiatement efficace le Centre-Pilote requiert-il un aménagement et un équipement de base que les milieux ruraux généralement ne possèdent pas.

Il lui appartient en conséquence, là aussi avec la participation de la collectivité, de réaliser ces "préalables" nécessaires.

Ces derniers concernent certaines constructions telles que : case pour l'Animateur de base, étable - fumière - petit magasin fermé.

Ces constructions doivent être édifiées avec les matériaux traditionnels - ceci pour bien montrer à la collectivité que ces infrastructures sont à la portée de leurs moyens et de leur savoir-faire.

D'autre part, pour l'Equipement du Centre-Pilote il y a lieu de prévoir l'achat d'un troupeau d'élévage (20 bovins), de boeufs de labours, de matériel de culture et de charrette de transport, engrais et de produits antiparasitaires.

Pour ces achats, le Centre-Pilote fait bien entendu l'avance des fonds à la collectivité participante, mais il est absolument nécessaire que cette dernière soit informée et ait accepté de rembourser ces avances, sur le croît du troupeau et les plus-values de récoltes, suivant des tranches annuelles à déterminer. Ce principe du remboursement doit être rigoureusement appliqué pour ne pas habituer la collectivité à une aide gratuite.

Le Financement pour le démarrage d'un Centre-Pilote de moyenne importance compte tenu des dépenses nécessaires aux Etudes préliminaires, peut se chiffrer approximativement comme il suit :

I°/- Etudes préliminaires :

- Socio-économiques-Agro-pédologiques
- (avec carte d'utilisation des sols et relevé cadastral des terres en cultures et en jachère, estimées à 1.300.000

II°/- Dépenses d'Aménagements :

- Case pour l'Animateur de base
- Etable - fumière (pour 20 bovins)
- Magasin - Bureau (15 x 5)
- Abreuvoir
- Couverture ou élargissement au buldozer des pistes de désserte des champs estimées ... 1.800.000

III°/- Dépenses d'Equipement :

- Achat de 20 bovins (noyau d'élévage)
- " -"-3 paires de boeufs de Labour
- Matériels de cultures
- Engrais-insecticides
- estimées à 1.400.000

3.500.000

Dépenses imprévues : 500.000

Soit au total 4.000.000

Remarques : a)- les dépenses (1) et (11) ne sont pas récupérables, ces infrastructures étant acquises à la collectivité accueillante, à charge pour elle de les entretenir.

b)- les dépenses d'équipement sont par contre remboursables sur le croît du troupeau et les plus values de récolte suivant des modalités (très libérales d'ailleurs) à préciser.

c)- le poste : "dépenses imprévues" peut paraître excessif mais il tient compte des variantes d'exploitations et des aménagements multiformes que les Centres-Pilotes peuvent requérir.

En tout état de cause, si dans ce montant on fait abstraction des dépenses d'équipement qui sont remboursables, on peut considérer que le lancement d'un Centre-Pilote, moyen, intéressant par exemple un village groupant une collectivité de 200 âmes, nécessite un investissement au départ de 2.500.000 francs.

Même si l'Etat doit en outre prendre en charge le salaire de l'Animateur de base (12 à 15.000 par mois), ce n'est pas payer trop cher une entreprise qui, si elle est bien conduite tant sur le plan Psychologique que Technique, peut aboutir en 3 ou 4 ans, à orienter une collectivité sur la voie du progrès, en lui apprenant les "gestes" d'une meilleure agriculture.

Et si l'on admet l'effet "rayonnant" et "contagieux" des Centres-Pilotes, on peut sans excessif optimisme, penser qu'une vingtaine de Centres-Pilotes judicieusement répartis - dans une Région donnée, pourrait la sensibiliser au progrès agricole, en quelques années.

Ceci, par la seule vertu des exemples, des démonstrations des enseignements pratiques dispensés sur place auprès des paysans Ceci, sans heurter leurs traditions, ni attenter par la contrainte à leur liberté ; ceci, sans recourir aux méthodes coûteuses, imprudentes et par là très discutables, qui ne voient, la modernisation Agricole de l'Afrique Noire, que dans l'extension de la collectivisation des cultures.

Conclusion :

L'évolution agraire de l'Afrique Noire, suppose certes des mesures d'ensemble comme celles que le Gouvernement de la Côte d'Ivoire a heureusement prévues et édictées.

Mais toutes ces mesures seraient incomplètes, voir même illusoires, si l'on ne s'attache pas en priorité à transformer la mentalité paysanne, restée par ignorance ou par résignation, plus ou moins indifférente et insensible à tout progrès.

Les Centres-Pilotes de prévulgarisation semblent répondre à cet impératif. Les quelques expériences (trop limitées hélas) faites en Côte d'Ivoire peuvent en témoigner.-

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Agenda Item: C.1.3

Ivory Coast

PREPARATION OF THE RURAL WORLD OF AFRICA TO MODERN AGRICULTURAL PLANNING BY THE PILOT-CENTRES OF DIFFUSION AND DEVELOPMENT

By J. E. LALANDE,
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Conseiller Technique aux Etudes
et à l'Expérimentation Agricole en Côte-d'Ivoire

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Preparation of the rural world of Africa to modern agricultural planning by the pilot-centres of diffusion and development

SUMMARY :

Any attempt to modernize the rural world of black Africa cannot be conceived without a whole set of governmental interventions, such as: training of rural experts and leaders, creation of public utilities and distribution of farming equipment, creation of Experimental Stations for the improvement of farming techniques and yields, loans to farmers (Crédit National Agricole), organization of marketing and distribution facilities, etc.

However, government measures as such are not enough to start any process of farm modernization.

More than the mere improvement of farming techniques, farm modernization means first of all a good amount of forgetting old farming customs and real change in the way of living.

One knows how staunchly the African farmer (be it out of respect, ignorance or resignation) clings to his tribal customs. This fact explains the indifference, if not the hostility which he still opposes to the pressure of progress. In any case, we may say that the majority of African farmers are not ready yet, mentally speaking, for rural evolution.

Thence the imperative necessity to increase the yields of the rural collectivities for their better living and higher prosperity. Through such a forward movement they would be in a better position to " grasp" the meaning of progress, psychologically.

This is the aim of the Pilot-Centres for diffusion and development, which may be defined as " cells" of psychological and technical impregnation. The Centres are established among farming collectivities which they try to direct towards prosperity by teaching them progressive cultural methods. Theories are put into practice on the spot. In short, the Centres study the physical and human environment in order to work out more productive farming formulas, which then they demonstrate practically. They develop the farmers' sense for mutual aid and teach them how to group professionnaly, thus giving form to a cooperative structure; this

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organization will then permit: loans for the different campaigns, commerzialisation and distribution of surplus products, etc.

In short, the Pilot-Centres study and prepare for each village its own modernizing system. The influence of their work is very strong even outside the collectivities, so that a whole region can be transformed when enough centres are established there. These centres can vary in dimension and aspect and are thus adapted to different circumstances and environments.

The pilot-centres remain for the rural world of black Africa the most efficient and economic means to direct them towards modern agricultural progress.

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United States of America

THE EVOLUTION OF SOIL SCIENCE AND ITS APPLICATION TO HUMAN PROGRESS

By Richard BRADFIELD,
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THE EVOLUTION OF SOIL SCIENCE AND ITS APPLICATION TO HUMAN PROGRESS

by
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1. Human progress is slow and limited as long as people are required to use a high proportion of time to gather or produce enough food to keep themselves alive. The time required to produce enough food to meet the needs of a population depends primarily upon two factors: (1) the quality of the environment for growing food crops, and (2) the skill with which crop needs and environment are adjusted and synchronized. Progress is usually most rapid in areas where the natural environment is very favorable for food production or where it can easily be made very favorable. The early civilizations in the western world developed in the valleys of the Tigris and Euphrates Rivers in Mesopotamia, and in the Nile Valley of Egypt. Both of these areas are noted even today for their fertile soils, and in addition, have readily available from the rivers, ample supplies of water for meeting the demands of crops. Once these people had learned to spread this water over the soils, the success of their agriculture for a prolonged period was assured. Furthermore, these areas had temperatures favorable for growing good food crops and a relatively low humidity which was favorable for the growth of a great variety of crops but was not particularly conducive to the growth of many pests which restrict yields.

2. If the skills and technology of a people are not highly developed, an abundance of cheap food will be produced only in those environments which are very favorable for crop production under natural conditions. But as science and technology advance, the deficiencies of many environments can be diagnosed and corrected and food production can be expanded progressively into less and less favorable areas. Certain deficiencies are difficult to diagnose and are a barrier to agricultural development until science reaches a rather high level. Once the cause is determined, the remedy may be relatively simple and inexpensive to supply, but production is usually more expensive than on soils which are naturally very fertile. Because of this fact, the stronger and more aggressive elements in a population tend to acquire the best land and as the pressure of population increases and the people are forced to settle the less fertile land, it is usually the less skilled people who are forced out and compelled to farm the poorer soils.

3. Progress in such areas tends to lag because the soils with the most difficult management problems tend to get into the possession and fall under the management of the less qualified people. This pattern of land ownership exists in many less developed countries today. The better land is owned or controlled by people of greater means and better education, usually in rather large tracts. Fairly modern scientific management is used to produce crops, largely for export, as these crops generally return the highest profit per hectare. If land is abundant, this better land

may be farmed extensively or not at all and large tracts are often held intact awaiting higher and higher prices. These patterns of land ownership were established or at least initiated in most countries long before the development of soil science.

The Early Development of Soil Science

4. Thinking men, in all cultures and in all ages, have been intrigued with the causes of the differences in the productivity of soils. Many of Rome's most distinguished statesmen were also keen students of soil management. Although the basic sciences had not yet developed and they were consequently unable to find the reasons for many phenomena which they observed, nevertheless, as a result of systematic observation, they were able to develop certain practices which greatly improved the quality of their harvests. The use of manures, the influence of leguminous crops and the beneficial effects of limestone on certain soils were observed at an early date. The famous Norfolk rotation was developed in England and widely applied before our knowledge of chemistry was adequate to explain the reasons. This development alone, is accredited with doubling the yields of wheat in Britain.

5. The art of soil management, then, had made considerable progress by empirical techniques long before soil science developed. This was due largely to the fact that soil science is, in many of its aspects, an applied science of great complexity. In order to obtain an understanding of its mysteries, tools of research developed by chemists, physicists and microbiologists, et al, had to be perfected for simpler systems before they could be applied to the complex systems in soils. Soon after Berzelius, Liebig and other chemical pioneers developed methods for the chemical analysis of plants and rocks, these tools were applied to soils, manures and crops grown on soils with different manurial treatments. This approach supplied data which eventually gave an insight into the reasons for the effectiveness of management practices which had long been used by the better farmers.

6. Soils had many properties which attracted the attention of the early students of physics. They differed widely in their capacity to swell, shrink and crack, in the ability to transmit, absorb and retain moisture; in their tendency to granulate under certain conditions and to disperse under others. They responded very differently to the action of frost. Many diverse environmental factors were found to influence the temperature of soils and these temperature differences had in turn an effect upon the early growth of crops, especially in temperate regions. Physicists observed quite early that the relationships between water and soils were quite complicated. Some of the water moves through soils with but little resistance under the influence of gravity, while part of it is retained with forces so great that plant roots are unable to extract it. These problems have been studied for over a hundred years but scores of soil physicists continue to find facets of the problem fascinating and not yet satisfactorily explained.

7. When the microbiologist examined the soil with his newly discovered techniques, he found that it was inhabited by a very complex flora and fauna, with millions of microorganisms actively engaged in tearing down the plant and animal residues which happen to fall upon the soil and converting them into a material called humus, a product characteristic of soils. Later, about 1870, they discovered in the nodules of the roots of certain legumes, bacteria which had the unique capacity of absorbing elemental nitrogen from the atmosphere and building it into the proteins

necessary for their life processes. At last the reason for the beneficial effects of legumes upon succeeding crops, observed centuries earlier by Roman farmers, was partially explained. This subject has been energetically pursued since that time, but all facets of this very basic problem have not yet been fully clarified.

8. Geologists were interested in rocks and in the processes by which they disintegrated or weathered and were finally transformed into soils. In the case of young soils, the characteristics of the soil were plainly influenced by the nature of the rocks from which they were formed. The earliest efforts to classify soils were based upon the nature of the rocks from which they originated. As studies were expanded into areas in which the soils were much older geologically, the influence of the parent rock became less obvious and in many cases disappeared altogether. This necessitated a restudy of the problem of the classification of soils and led Dokushaiev and his students to develop a genetic system of classification, based primarily upon the properties of the soil profile itself. This was a great step forward. But, as it was applied to soils in different areas, it too, was discovered to have weaknesses and efforts are now underway throughout the world to develop more satisfactory systems of soil classification. Soil scientists are approaching the problem with more caution than in early years and the latest effort in this direction is referred to as the "7th approximation", indicating that the best we have today is recognized as being imperfect and merely one more stage toward our ultimate goal. Nevertheless, a great deal is known about the soils in various parts of the world. We know what the major types of soil are and we know in a general way where they are located and something of their agricultural potential. An international cooperative effort is underway to produce a soil map of the world. It will not be perfect when completed, but it will represent an additional coordinated effort to supply a picture of the soil resources available to us.

9. A soil survey can be of great value to the leaders of a developing country. If they are to plan wisely, they need to know what soils they have, where they are located and what use they can best serve. They will need to establish priorities for the development of different sections of the country. Cities will have to be located, highways will have to be planned, agricultural research and educational centers will have to be established in the most favorable locations. It is important that these research stations be well located so that the findings made there will be applicable to large areas having similar soils in other sections of the country.

10. Botanists, plant physiologists and ecologists can also make important contributions at this stage. A study of the natural plant cover should accompany and supplement the soil survey as it will often provide clues of value for determining the agricultural potential of a new region. Knowledge of plant physiology is indispensable to the student of soil fertility. Thus, we see that all of these sciences contribute to soil science and to our understanding of the soil as a medium for the growth of crops.

The Soil as a Medium for the Growth of Crops

11. The soil is a living, dynamic system which undergoes many cycles of changes which need to be understood when planning management practices, for it affects the growth of crops in many ways:

(a) It must be a medium suitable for the germination of seeds and

favorable for the development of a healthy root system.

(b) It must have a chain of pores open to the atmosphere and capable of conducting enough oxygen to the roots to meet their respiration needs.

(c) It is the source of water for the plant and must have a capacity for storing water for the use of the crop during the periods between rains. This is extremely important in areas where the rainfall is inadequate or poorly distributed.

(d) It is the source of all the nutrients essential for the growth of the crop. The macronutrients; calcium, magnesium, potassium, nitrogen, phosphorus and sulphur are needed by practically all plants in relatively large amounts. In addition, all plants require small amounts of manganese, copper, zinc, boron, molybdenum and iron. Only minute traces of the latter group are needed in the enzyme systems of the plant, but their absence may result in crop failure. These requirements are specific and one element can substitute for any other to only a very limited extent.

12. It is especially important that adequate amounts of nutrients be present at the time the crop is being established. It will help to get the crop off to a good start. Most crops grow much more rapidly at one period than at another. It is important that the supply of nutrients be adjusted to and synchronized with the needs of the crop at each stage of development. The supplies of all of these nutrients need to be properly balanced. It has been known since the time of Liebig that the amount of growth of a plant is limited by the supply of the nutrient present in smallest amount in proportion to the requirements of the crop. This "law of the minimum", refined in many ways in the last century, is still one of the cornerstones of soil management. The problem of maintaining an adequate supply of nutrients in soils in a form in which they can be absorbed by plants is complicated by the fact that readily soluble nutrients are washed out of the rooting zone during periods of heavy rains. Some of the nutrients supplied react with the soil and in many cases form compounds which are so insoluble that their effectiveness is greatly reduced. There are all grades of interactions between these extremes which the intelligent farmer must understand and appreciate in devising efficient systems of soil management.

The Present Status of Soil Science

13. Soil science has reached a fairly high state of development in the technically more advanced countries. The larger of these countries can number their soil scientists in the thousands, the smaller countries in the hundreds. Most of them have good institutions for the advanced training of soil scientists and the quality of this training is steadily improving. The proportion of soil scientists trained to the Ph.D. level is increasing each year and in many countries job opportunities are limited for those who are not trained to this level.

14. Research in soil science in these countries has greatly expanded in the last two decades. The volume of literature emanating from their laboratories has greatly increased. Each of the major countries has its own professional society of soil scientists with large memberships which bring their members together at intervals for the reading of papers and

the exchange of ideas. The International Soil Science Society has been in existence for almost half a century and has about 4,000 members in 74 countries. Meeting at intervals of from 3 to 5 years, it brings the soil scientists of the world together for technical discussions and personal contacts. The volume of technical literature in soil science is so large that no one can hope to keep up with all of it. This has resulted in the preparation of many specialized monographs which review in a critical way, the literature dealing with specific areas.

15. In order to bring new developments to the attention of interested farmers, extension workers are trained in soil science and their training is kept up to date by frequent conferences with research workers. In the advanced countries, important discoveries in soil management are brought to the attention of farmers and put to use by them with a minimum of delay. In many cases, the more alert farmer is applying new research information on his farm before it is published in a technical journal. Governments are supporting research more liberally than in the past, because they have found that it is one of the best investments that they can make. It is difficult to evaluate the contributions which agricultural research has made to the development of the more advanced countries, especially in the last quarter of a century, but they have been very substantial.

16. In the United States for example, less than 9 percent of the population is now living on farms. This small fraction of the population is producing all of the food needed by the entire population with surpluses for export trade and for meeting emergencies throughout the world. The cost of food to the consumer has been lowered when expressed as percent of income. The wage earner is now spending only about 20 percent of his wages for enough food of high quality to support himself and family. Over 90 percent of the population has been freed from work on farms to perform other services demanded by our rapidly growing economy and for cultural pursuits. All of this is being done with less land under cultivation than 25 years ago, and there is every evidence that the productive capacity of the land now farmed is being maintained. While the yields of many crops have more than doubled in the last quarter of a century, there is abundant evidence that we have not yet reached our peak. As a matter of fact, there is rather convincing evidence that the present yields of crops can be doubled with but little, if any, increase in unit costs of production.

17. The status of soil science in the less developed countries is, in many cases, lamentable. They have but few, if any, trained soil scientists, but few laboratories and these are often poorly equipped. Their libraries are small, the books and journals often poorly selected and out of date, and therefore, often little used. Many institutions in which agricultural workers are being trained suffer from the same deficiencies. In many of the former colonial countries, the situation has frequently deteriorated since independence. Most of the better trained scientists were expatriates and many of them have left without leaving qualified replacements. Most of the great tropical research centers have been closed down and in many cases it will be years before they can resume a research program comparable in scope and quality with that underway a decade ago.

18. The situation is aggravated by the fact that agriculture is often held in low esteem by the young people now receiving an education in these countries. They are anxious to get jobs in the city and are more interested in glamourous subjects like atomic physics and space exploration than in

soil science. International trade is bringing many new, attractive products and conveniences to their markets. They naturally want to industrialize and make these products in their own countries. Unfortunately, they do not see or fully appreciate the significance of the efficient agriculture which has made such industrial developments possible in the countries with a more mature economy. Changing such attitudes and building up a corps of able teachers, research workers, and other leaders for agriculture, is one of the most important problems confronting many of the developing countries.

Applying Soil Science for Human Progress

19. Soil science, as we have seen, is basic to improved agriculture but it is not a simple matter which can be applied overnight. If we are to benefit from its full potential, it must be the central core around which an integrated system of management is developed. This system of management, to be efficient, must include the best combination of practices which plant breeders, agronomists, plant pathologists, entomologists, plant physiologists, agricultural engineers and other specialists can devise. As pointed out above, many of the advanced countries are now reaping an abundant harvest from the investment made in agricultural education and research over the last hundred years. There is every reason for thinking that the potential for development is equally great in the agriculturally underdeveloped countries.

20. A high proportion of these countries lie in the tropics. They have problems that are different and in some cases more difficult than corresponding problems in the temperate region; but they also have the very great advantage of having a growing season 12 months long which permits the growth of crops throughout the year. It has been estimated that there are over 200 million people supporting themselves by some form of "shifting agriculture" or "natural fallow" in the tropical areas. They are exploiting over 3.5 billion hectares of land for it requires, under this system of management, about 15 hectares to support one person. This is a very remarkable system of agriculture developed many centuries before the principles of modern science were discovered or the products of modern industry were available.

21. It developed in slightly modified forms in the tropical sections of all the continents and is widespread in Africa, Asia and Latin America. It consists of clearing land from jungle, burning the cover, planting to crops for from three to five years; then, as yields decline and weeds increase, the land is abandoned, the jungle takes over for from 15 to 20 years and then the cycle is repeated. From 85 to 90 percent of the people must engage in farming to produce enough food to support themselves with this system. Under such circumstances, these people can contribute but little to human progress except how to subsist in a hostile environment. It works satisfactorily until population pressure forces a lengthening of the cropping period and a shortening of the fallow period. When this occurs, the beneficial effects of the fallow decrease, crop yields decline, and the people are forced to reduce their numbers or to migrate.

22. Taiwan is a good example of what can be done by an industrious, literate people with good technical leadership, by the application of science to a situation requiring very intensive management in a tropical environment. This tiny island, three fourths of which is mountainous, has developed an agriculture which supplies its population of about 10 million people with a diet far above the average in Asia, and a surplus of sugar, bananas, pineapple, pork and other products for export to

neighboring countries. This has been done by the skilled use of fertilizers, good seed and cultural practices combined to give yields of crops which compare with the best obtained anywhere. In addition, they have developed an ingenious system of multiple cropping which gives from 2 to 5 crops per year. As a result of such combinations of farming practices, the farmers of Taiwan often produce from 10 to 30 times as much food per hectare as is produced under the shifting agriculture system.

Summary

23. Human progress is slow as long as people must devote a high proportion of their time to producing enough food to feed themselves. The amount of time required depends upon the qualities of the environment and the skill with which it is managed. The labor required for food production is usually high when crop yields are low. Crop yields are higher when the natural environment is favorable or when it can be made favorable by skilled management. An understanding of the principles of soil and crop science is essential to the development of the sound management practices necessary to obtain higher yields.

24. Soil scientists are confident that the world has the soil and water resources necessary to produce an adequate diet for all the peoples of the world for at least a couple of generations, if they are properly developed and managed. The experience of Mexico, Taiwan and many other countries indicates that it is now possible to expand food production at rates from 5 to 8 percent per year. This is about twice the rate at which populations normally increase. Most of the broad scientific knowledge necessary is already available. The additional information needed on local environment can be obtained within a decade or less. There are, however, other requirements which must be met if we are to put this knowledge to work.

25. The efficient development and use of these resources will require: (a) increased sources of power and the machines necessary to use it, (b) increased supplies of fertilizers and lime, (c) increased supplies of chemicals for pest control, (d) better seeds, with greater genetic potential for utilizing the improved environment, (e) better water control; drainage to remove harmful surpluses and irrigation to supplement deficiencies in rainfall.

26. The amount of capital required for these developments is large. Fortunately, most of these expenditures, if wisely made, can be self liquidating. The more highly developed countries have found that such investments are very profitable. They should be autocatalytic in their effect on the economy of the country. If wisely handled, it will cost much less to make the necessary investments than to fail to make them. The advanced countries have made them and are now reaping the benefits, the less developed countries have not and are suffering as a result.

27. Progress in a country is more frequently limited by the attitudes, motivation and capabilities of its people than by all other factors. In many of the less developed countries people of wealth and in positions of great power are preoccupied with maintaining status quo. Usually this attitude is shortsighted in that it fails to recognize new outlets for their talents and resources and tends to inhibit their overall economic and social progress so important to all elements of the population.

28. In this scientific age, the development of a country is more likely

to be limited by its supply of educated people than by any other factor. An investment in the education of its people is one of the most profitable that a country can make. Unless it is made, the returns from all other investments will be jeopardized or at least reduced. Modern agriculture and industry cannot be directed and operated efficiently by uneducated men. The proportion of highly trained men required is steadily increasing. To produce the numbers of educated men needed, teachers, schools and universities, and time are needed. Until local personnel can be educated to the required level, and in sufficient numbers, leadership from other countries should be recruited. Men with experience in the agriculture of the country or region should, in general, be preferred. Well trained, experienced, sympathetic expatriates, if properly supported, may be among a newly independent country's most valuable assets during the difficult period in which school systems are being expanded, universities and agricultural research facilities developed and other essential services and goods provided.

29. The experiences of several countries in the tropics and that of a few exceptionally skilled farmers in most other countries, seem to justify our faith that farmers in practically all countries can produce enough food and other agricultural products to meet the basic needs of their people. If they are to do so, however, the soil and other resources of the country must be wisely developed and managed. Efforts to ensure this should receive top priority in all countries.

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FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

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Agenda Item: C.3.1

United States of America

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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